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ABSTRACT

This report outlines the most pressing challenges facing California K-12 educators as they seek to prepare students for work and citizenship in the 21st century. The report also explores public expectations about technology and education, and it touches on some of the ways in which the education community itself is attempting to harness new computer and Internet tools to enhance student achievement both directly, in the classroom, and indirectly, through education's administrative and professional development systems. The first section discusses technology and change. Tackling the challenges in the following areas is addressed in the second section: literacy; teacher quality and professional development; standards, assessments, and accountability; achievement gap; and the importance of information for student management, accountability, decision-making, and instruction. The next section explores roles for technology in each of these areas, and wise technology investments is considered in the fourth section. Specific examples of how California districts, schools, and individual educators have begun using new technologies are appended. (MES)

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High Stakes: Key Challenges for California Schools and the Role of Technology

A Report from the California Education Symposium

December 10, 1997

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WestEd

Improving Education through Research, Development and Service

High Stakes: Key Challenges for California Schools and the Role of Technology

A Report from the
California Education Symposium

December 10, 1997

Prepared by
WestEd

KEY CHALLENGES

California's public schools are facing a high-stakes test. To pass, they must demonstrate that they can raise the academic achievement of all students to the levels deemed necessary for successful citizenship and work in the 21st century.

Given the enormous challenges facing California educators, achieving this will not be easy. California has the largest and fastest growing, as well as the most diverse and urban, student population in the nation — accounting for one of every eight American school children. At the same time, the state has been managing the nation's largest class size and doing so, according to many studies, in physical plants that are among the country's most deteriorated. The state also has among the country's lowest annual per-pupil expenditures and must contend with the country's highest rate of children living in poverty.

The spotlight on education in California is, as in states across the nation, intense. A 1996 poll found that only 17 percent of citizens rate its schools as "excellent" or "good," while 54 percent called for a major overhaul of the public education system. The generally poor showing of American students on the most recent international comparison of mathematics and science performance serves only to reinforce the public's concerns that public education must be improved (The Third International Mathematics and Science Study (TIMSS). Parents of all races and socioeconomic groups have expressed support for a number of reforms, including high academic standards, tougher graduation requirements, and better assessments.

Parents — and the larger community — also are looking to technology as a powerful means of improving schools. A recent Phi Delta Kappa/Gallup poll, in which respondents were supplied with a list of 10 possible reforms for improving education, found that the reform garnering the most support — 81 percent — was putting a computer in every classroom. On the national level, the President also has thrown his support behind technology, while other government and business leaders came together at the 1996 National Education Summit to discuss potential roles for technology in education.

While a variety of technologies have long been used in the classroom — from books and blackboards to pencils and projectors, today's computer and Internet tools are in a whole different league. Such is the role of these tools in the business world that, not surprisingly perhaps, the public has extremely high expectations for the role they might play in improving education.

Yet, incorporating such technology into education in any meaningful way is neither easy nor inexpensive. Nor does it offer a panacea for the challenges faced by today's educators. In fact, it appears, if technology is to contribute to school improvement, administrators, principals, teachers and other education stakeholders must have clearly defined educational goals and a plan for how a particular technology might be used to help reach them. It almost goes without saying, then, that a clear understanding of how — and the degree to which — computer and Internet technologies can support improved student performance must be premised on a deep understanding of education's most compelling challenges. As Jan Hawkins, director of the Center for Children and Technology, noted at the National Education

Summit, meaningful applications of technology will result when all education stakeholders work together to reach consensus on the objectives for their school or system.

To that end, this report outlines the most pressing challenges facing California educators as they seek to prepare the nation's largest and most diverse school population for work and citizenship in the 21st century:

- **Literacy:** Can the schools boost the reading and writing skills of all students substantially from current levels? How can educators get the most out of the new Class Size Reduction initiative?
- **Teacher quality:** Can California develop the workforce it needs to teach to higher standards?
- **Standards, assessments, and accountability:** What goals and tools do educators and students need if students are to improve academic performance?
- **Achievement gap:** What can be done to strengthen the achievement of pupils whose performance consistently lags behind that of other groups?
- **Information for decision-making:** Do educators have the data they need to analyze problems, develop plans, make decisions and help parents understand how their children are progressing?

The report also explores public expectations about technology and education, and it touches on some of the ways in which the education community itself is attempting to harness new computer and Internet tools to enhance student achievement both directly, in the classroom, and indirectly, through education's administrative and professional development systems.

Originally conceived as a discussion paper for IBM and WestEd's jointly sponsored California Education Symposium in December 1997, this report has been updated to incorporate results from that conference, which was attended by some 200 of the state's business and education leaders. It is now offered as a starting point for constructive, action-oriented discussion in communities throughout California by those committed to making high quality K-12 education a reality in this state. While school districts across the nation are grappling with these same challenges, Californians need to examine and resolve them within the local context, based on their own priorities, resources, and circumstances.

TECHNOLOGY AND CHANGE

As educators know better than anyone, technology is not really new to schools. Teachers and students have been making good use of learning tools throughout the history of formal schooling. In one of the more sophisticated examples, distance learning programs, relying on a combination of video, telephone and early computer technology, became a fixture long before the arrival of the World Wide Web.

But there's something different going on today. Growing numbers of education stakeholders — including teachers, policy makers, parents, the business community and even

the nation's President — believe that these new technologies can help schools address some of education's most pressing challenges. Indeed, new computer and Internet technologies offer alluring possibilities: the ability to move beyond the classroom walls without ever leaving your seat; to easily access rich source material and the most up-to-date information; to communicate immediately; to network with peers over time and space — and that's just for starters.

While technology's power as a tool for enhancing teaching and learning is most critical, it is also important to the public — and parents especially — that our youth become computer literate, learning how to use those technologies increasingly required in the workplace. In California, having students develop a familiarity with and, indeed, affinity for computer and network technology is of concern, given the need for high-tech workers in the computer industry. The 1992 SCANS report included the ability to use personal computers among the essential employability skills that students should possess by the time they graduate from high school. And the formal statement crafted by state governors and business leaders at the 1996 National Education Summit hosted by IBM offers a broader vision of technology's place in education that is probably an accurate reflection of overall public expectations:

> We are convinced that technology, if applied thoughtfully and well-integrated into a curriculum, can be utilized as a helpful tool to assist student learning, provide access to valuable information and insure a competitive edge for our workforce. It can be used by trained educators in classrooms and other places students learn, such as in libraries, in museums and at home. Interactive learning enables parents and educators to find new ways to help students improve academically, while helping students learn to use the tools that are being used not only in today's high-technology workplaces, but increasingly in any workplace. We cannot reach higher standards without developing new approaches and strategies to help students, teachers and parents. While not a silver bullet, technology is one important tool to accomplish this.

Having witnessed or heard about dramatic changes in the U.S. economy and the nature of jobs, most people now see their children's ability to manipulate technology comfortably as necessary to their success in a society where strong skills are much more important than strong backs. As the economist Lester Thurow puts it: "The skills of the workforce are going to be America's key economic weapon in the global competition of the 21st century." A major implication of this "knowledge-based" economy, he emphasizes, is this: workers with high skills will command good wages; workers with limited skills will struggle economically. While by no means sufficient for success in the work place, the ability to use new and evolving technologies to gather, analyze, communicate and/or discuss information and ideas is essential in a knowledge-based economy.

These expectations place a heavy burden on the shoulders of educators, who must cut through the visionary rhetoric and focus in on the realities. Complicating the task has been that, too often, technology proponents in their enthusiasm have focused primarily on the promise of the tool and only secondarily on the specifics of how it could actually be used educationally — a little like the proverbial carpenter who, hammer in hand, sees everything as a nail. In many schools, one finds lots of technology but no consensus about how it is

expected to be used or to what end. That said, like the hammer, if applied appropriately, computers and new telecommunications technologies may prove very effective in helping to address certain education challenges.

Much remains to be seen about how advanced technologies can best serve education. Unlike the world of business, which has been refining its uses of digital technologies for decades, educators are just beginning to develop the infrastructures of equipment and knowledge that will permit broad experimentation and adaptation of technological capacities in the educational process. Nobody has been able yet to fully gauge the upside potential of new technologies in instruction, in teacher development, in administrative information-sharing or in a number of other areas that affect student achievement.

Studies of so-called technology-rich schools like Port Hueneme's Blackstock Junior High have found many of the qualitative changes called for by education reformers, such as learner-centered programs with clearly articulated goals for students, detailed curriculum frameworks in core subjects, increased teacher collaboration and more individualized instruction. But whether there is a cause and effect relationship between these changes and the technology, or whether the technology simply served as added support for changes that were in the works anyway, is a tough call.

The educators, schools and districts cited in this paper are applying technologies in thoughtfully focused efforts to address specific educational challenges. And their resourcefulness in devising initiatives and stitching together the support and resources to develop them, despite often daunting financial and technical constraints, highlights the key factors in schools' use of technology: the keys are people and ideas. Putting technology's capabilities to work to improve education takes the same combination of human energy, commitment, imagination and spirit of collaboration that the whole enterprise requires.

No two classrooms, schools, or districts are exactly alike. And new digital technologies do not come in a standard-issue, one-size-fits-all package that educators can simply install and be done with it. The wise course is to start by defining educational goals and identifying very explicitly what the educational problems are that must be addressed. At that point, educators can legitimately ask: Can technology help us make improvements in this area? If so, in precisely what ways? This is where the discussion of technology implementation rightly begins. It is true that, as one California computer user puts it, "technology *is* change." But technology can't think, plan, analyze, make judgments, channel resources in the most productive directions. To harness change — that is what educators must do.

TACKLING THE CHALLENGES

Literacy

Among the states that participated in the National Assessment of Educational Progress in 1994, California had dropped almost to last place in reading. That glaringly poor performance put the focus on literacy as a top state priority. If California schools were to boost

all students to higher levels of academic achievement in general, they would have to begin by setting a solid foundation for literacy in the early grades.

In 1996, California adopted the Class Size Reduction (CSR) initiative, a $1 billion program to reduce K-3 class sizes to 20 pupils in the state's 5,048 public elementary schools, with a companion reading initiative that promised new reading materials and teacher training in "research-based" reading instruction. The initiative began with funding for three of the K-3 grades and was expanded by the Legislature in 1997 to cover all four of these primary grades.

While class size reduction alone will not necessarily improve reading scores, examples in other states and in many of the districts in California demonstrate that a comprehensive early grades initiative, leveraging the opportunities of reduced class size, can be a powerful approach. In instituting the initiative, however, educators in California face a number of daunting logistical problems, including:

- Having added more than 18,000 new teachers and classrooms in the first year alone, full implementation of the program will require the hiring of approximately 16,500 *additional* teachers.
- Providing new teachers with the professional development needed if they are to take advantage of the teaching opportunities that result from having fewer children.
- Supplying classrooms with high quality materials and resources. The 1996 reading initiative targeted $150 million for districts to buy new reading materials from the state's approved reading list. Unfortunately, California starts from a deficit in this area. Recent reports have pointed to widespread textbook shortages throughout California's public schools, including at the lower grades, and even in those classrooms with books, many are out-of-date. The state ranks 47th in the nation in textbook spending.

Further complicating the literacy issue for California's K-3 teachers is the fact that one-third of their students do not speak English as a first language. How best to help these children and others become literate in English is the focus of much controversy in the state.

Teacher Quality and Professional Development

Teacher quality is widely acknowledged as the most critical factor in whether class size reduction — or any other any education reform — will yield improved education for the state's youngest students. Yet simply getting enough educators for California's classrooms is, itself, a challenge. Class size reduction is just one of the factors contributing to a growing need for more teachers. The state is also dealing with a generational shift in its aging teacher workforce, a high annual teacher attrition rate and an enrollment boom. By most estimates, California schools will have to hire approximately 250,000 new teachers over the next ten years — more than its entire current teaching force.

Despite promising efforts like the state's nine-year-old Beginning Teacher Support and Assessment program and other education partnerships, more than 40 percent of the teachers in California classrooms today are on emergency waivers and/or teaching a subject for which

they have no training. In addition, the loss of experienced staff will leave new teachers without the role models and mentors that are considered key to professional development. Since teacher attrition rates are highest in the first three years of teaching and uncredentialed teachers are more apt to leave than those who have training, turnover among CSR teachers can be expected to be higher than average.

Furthermore, the need for high quality pre-service and inservice training — a distinction that blurs as new teachers get most of their training on the job — is particularly acute among the new K-3 teachers, who require clear grounding in methods, as well as feedback on their classroom style. Yet more than two-thirds of districts surveyed last year by the state's legislative analysts office said they were not able to do CSR professional development, half citing a lack of time and resources, and 69 percent saying that they could not round up enough substitutes to cover classes. While a California Research Bureau analysis of statewide survey data found that most districts now appear to be offering some CSR-related training, the focus has been on reading and mathematics instruction rather than specific strategies to take advantage of smaller class size.

In addition to finding enough quality teachers, California's schools also face the challenge of expanding the diversity of the teacher workforce. Also acute and growing is the need for urban teachers, special education teachers, and teachers with the language skills and training to bring bilingual students along academically.

Standards, Assessment, and Accountability

Clear academic standards, aligned with curriculum and assessment, is widely accepted as the starting point for helping all children learn and achieve at higher levels. It also is the cornerstone for accountability for parents and the wider community.

In late 1997 and early 1998, the State Board of Education adopted the state's first academic content standards, in English language arts (ELA) and mathematics, respectively. While the Board accepted largely intact the ELA standards proposed by the legislatively mandated academic standards commission, the commission's proposed mathematics standards, which stressed higher order thinking skills, proved more controversial. The Board opted, instead, to adopt standards that put greater emphasis on basic skills.

Now under development and expected ready for Board consideration in the fall are standards for science and history/social science. Meanwhile, many local education systems have already forged ahead with their own standards-based reform.

The success of standards-based reform is, of course, dependent on having curriculum that reflects the standards. It also requires assessments that measure progress and guide actions toward improvement — assessments that, therefore, must be based precisely on the material covered. Although California law now requires a statewide assessment that directly reflects the new standards, development of such an assessment cannot begin until all the standards have been adopted, probably late this year. Given that lag and given the public's intense interest in the performance of its schools, the Legislature last year authorized

purchase of an existing standardized assessment from a test publisher for use in the interim. That test — the SAT9 — will be given for the first time this spring.

Setting high standards and assessing student progress may accomplish little unless meaningful consequences are attached — for schools, teachers, and students. A number of states and local education systems have set exit and promotion hurdles for students. Others offer incentives in the form of financial and other non-monetary rewards for teachers. Poor performing schools may also become part of an intervention program that carries the threat of takeover by the district or state. In California, an education accountability advisory committee has recently submitted its recommendations for a system of rewards and sanctions tied to performance, which will be used to frame legislative debate. Its recommendations range from financial incentives of up to $2500 for teachers in high performing schools to state takeover of low performing schools.

Achievement Gap

A recent national study of minority achievement found that after nearly 20 years of dramatic academic gains, in 1988, minority students essentially stopped closing the gap with whites. Today only 3.7 percent of Latino students in California and some 5 percent of African-American students qualify for admission to the University of California. Enrollments in the state university system have dropped by 14 percent and about half of incoming students are considered to need remedial work.

The experience of other states strongly suggests that increased individual attention in the primary years is particularly beneficial for minority students. Although class size reduction brings individualized attention within reach for California's youngest pupils, many of their teachers lack the knowledge and skills to successfully teach youngsters who are not native English speakers and who are not yet proficient in English. Middle and high school teachers have similar professional development needs.

The other big question for California educators is how to strengthen programs at the middle and high school levels in ways that sustain minority students' motivation and achievement. A statewide task force of California educators concluded that the high school curriculum would have to be overhauled since too many students, including many minority students, are taking watered-down, undemanding courses in the general and vocational tracks that leave students unprepared for either college or skilled work.

The schools in which minority students show increased motivation, attendance rates, and academic progress typically have not only restructured and enriched the academic program, but also have taken additional steps, such as schools-within-schools, team-taught groups that stay together for several years, or small alternative programs.

Information for Decision Making

To make the kind of education change called for in California requires that decision-makers throughout the education community have adequate information at their disposal.

Unfortunately, the kind of meaningful and accessible data needed is more the exception than the rule in education.

Information is critical in a number of areas, including:

- **Student management**: California education agencies struggle to make a timely exchange of 750,000 to a million sets of student records each year, with records tending to trail the migrating student by an average of three weeks. This lag may result in unnecessary immunizations and retesting before class placement.
- **Accountability**: For parents and the community to know whether schools are doing the job of educating students, they need status reports.
- **Decision making**: Educators need timely data to analyze problems, plan ahead, and keep track of student performance. Administrators need data to help determine the fiscal impact of expenditures on student performance; identify trends in student health and academic needs; and evaluate teacher performance.
- **Instruction**: Teachers need student-level data across subject areas and other classrooms to identify ways to improve assistance and support to students.

The advent of the personal computer was both a blessing and a curse for schools' information management. The lower cost of these desktop machines put database technology within the reach of the smallest schools, and many have been able to capture and use valuable information. But this same autonomy also resulted in vastly diverse systems, which were as likely to capture the same data in different forms as they were to simply capture completely different data. Absent any kind of common approach, sharing student information has been impossible even for schools that use the same software.

While there are efforts to establish a standardized approach for gathering and disseminating education data on students, staff and school finance, many districts see implementing the standards as a drain on time and resources that will at least temporarily undermine their ability to provide student services. These efforts to share student records are made more difficult by the fact that schools must adhere to the guidelines of the Family Education Rights and Privacy Act, as well as provide for the security of information stored and transmitted electronically.

EXPLORING ROLES FOR TECHNOLOGY

Literacy

Experts in K-3 teaching agree that extensive class time spent on reading and writing, with close attention and feedback from the teacher, is the most important element in building basic literacy skills. Parents also play a critical role in laying a foundation for and strengthening children's reading abilities.

When used appropriately, classroom computers stocked with high-quality, interactive reading, writing, and math software can support young learners, while offering early-grade teachers added flexibility, as well as ways to tailor instruction to individual students. While some pupils are working on selected computer-based exercises, the teacher can conduct small reading groups or provide individual attention to others working at their desks.

For children whose parents don't — and in some cases can't — read with them at home, new speech recognition technology has the potential to provide important additional reading practice at school. ~~The~~ This technology can also provide extra support to children struggling with language barriers or mild learning disabilities or who may lack the basic grounding in reading that is necessary for proficiency. For their part, Internet connections are helping improve reading and writing skills by engaging students in research activities that spark their curiosity and motivation to learn and by providing teachers with new, effective literacy projects and lessons.

Professional Development

The potential of distance learning technologies notwithstanding, technology alone is not likely to solve the current structural supply and demand problems in the teaching profession. But telecommunications networks expand the flow of information and guidance available to teachers on an as-needed basis. Through online networks that break through the intellectual and personal isolation of the classroom, teachers nationwide now share lesson plans, discuss classroom problems, and debate instructional strategies in Internet discussion groups. The Internet also offers original source materials and research tools for teaching in every grade and academic discipline.

Schools of education are beginning to use networks to create new kinds of professional partnerships with teachers. Teacher educators predict that in the next few years Internet-based courseware will make interactive distance learning a commonplace of continuing education. As technology becomes more prevalent in the classroom, teachers also are learning to incorporate technology in teaching core academic subjects.

Standards, Assessment, and Accountability

As education communities wrestle with standards development and implementation, they use the Internet to find extensive standards samples and "best practice" information that can inform their consensus-building efforts.

Software designed to assess students' academic needs and achievement levels also has become more sophisticated. Software targeted to specific types of academic and developmental problems can provide teachers and schools with useful guidance in fine-tuning instruction and academic improvement programs for individual students. Technology also can be woven through the curriculum to create new interdisciplinary approaches to core academic studies.

Technology can give students opportunities for involvement in activities far more complex and challenging than might typically be possible in an average classroom.

Simulation technology, data analysis tools, and writing and presentation tools can be used in performance-based assessments that can give students real opportunities to demonstrate their learning in ways that paper and pencil tests do not.

Interactive multimedia formats give student and teachers ways to capture student work in electronic portfolios that can be viewed by parents and others to help document student achievement. These alternative assessments offer an opportunity to evaluate how students' knowledge structures and thinking skills may be changing as a result of using technology and other tools.

Assessment is most useful when results are used to guide classroom practice. With that in mind, technology can be used to help schools find new ways to collect, maintain and share such information, making it accessible to teachers.

Achievement Gap

Computer-using educators nationwide remark on the phenomenon, that students' motivation noticeably rises when they are working with computers. Particularly for those who do not have access to computers at home or who have not experienced feelings of academic success, research has shown that the motivational stimulus of instructional computing can be great.

Internet and distance learning technologies are enabling students whose experiences may be limited by family poverty to connect to the world's diversity: art museums, advanced science research, libraries, information archives on every conceivable subject and the global community of computer-using students and experts. Rich educational software also is enriching curriculum, enabling sophisticated simulations of lab experiments and examination of 3-dimensional geometric objects.

In addition, to prepare noncollege bound students for a high-skills work world, some school districts are establishing student support teams to help maintain the school's networks and equipment — and providing participants with career training and skills.

Information for Decision Making

Recent advances in data warehousing and data mining, database management, networked information sharing and advanced security procedures such as encryption technology make it increasingly easy for education stakeholders — from teachers to taxpayers — to collect, use and share the information that is essential to informed decision-making.

A growing number of school districts are using technology to expand communication with parents and the broader school community about academic issues. Some have incorporated town-meeting style forums to solicit parental ideas on how to improve the curriculum into their planning and then post the meeting reports on their web sites. Many districts and individual schools also post both their academic standards and suggestions for parental involvement in children's learning. Others are using networking technologies to

make information about individual students' academic progress available to their parents and to encourage communication between parents and teachers.

In California, school and grade level results (although not individual student results) from the upcoming statewide assessment must be reported on the Internet.

MAKING TECHNOLOGY INVESTMENTS WISELY

California's new school-technology initiatives, such as Digital High School, provide a rare opportunity for schools and districts to study their information and instructional needs to ensure that technology investments leverage maximum versatility, scalability (the capacity to grow when additional capabilities are needed) and utility. The planning process is important and school people shortchange it at their peril.

Such planning should start with a comprehensive examination of the school's precise teaching and learning objectives, says Bob Walczak, executive director of Computer-Using Educators (CUE), a statewide professional organization for some 10,000 school technology coordinators, teachers and other school proponents of networking. With list in hand they can then start exploring the areas in which there might be a technology solution. Use those specific objectives as the starting point for any conversations with vendors, says Walczak.

Data managers and technology experts recommend that school and district-wide infrastructures be planned for both professional and student usage, because network architecture that is not designed to be multipurpose and expandable can be a growing headache in the long run.

On the other hand, there is a kind of built-in pressure with technology to go for top-of-the line ideas. Experts caution that there are usually lower-cost alternatives — such as proxy servers rather than Internet connections in every classroom and using older machines for word processing and e-mail so that multimedia machines go for high-end instructional uses. Schools can "scale up" from modest beginnings — such as dial-up connectivity to the Internet rather than a direct link. In addition, school technology planners should familiarize themselves thoroughly with developments in the field of wireless communication, because emerging wireless telecommunication technologies may eliminate the need for costly cable installation in some instances.

Extensive written information and professional expertise on networking schools is available from those who have already gone through the planning process. But authors of a 1995 report on school networking in California made a point of noting "how seldom districts looked to other districts either inside or outside of California for assistance and information." They added: "Even among the technology leaders whom we visited there did not appear to be very extensive interaction with other school districts experienced in networking."[1]

Building an efficient, flexible system of hardware, wiring and software to serve multiple purposes requires substantial technical knowledge. The networking study noted that most

districts undertaking networking efforts underestimate significantly the effort required to network their entire district. Educators also tend to underestimate the degree to which computer networking, even at the school level, requires skilled staff support and an ongoing budgetary commitment. School technology planners should, for instance, become knowledgeable about the budgetary implications of connectivity rates charged by the local phone company. The Federal Communications Commission has authorized a new universal service for schools and libraries known as "E-rates," which will provide up to $2.2 billion to subsidize K-12 networking. (See FCC web site for more information: **www.fcc.gov/Welcome.html**)

It may be useful to remember, too, that "technology" can also refer to something other than computing. Some schools have found, for example, that one of the best technology investments they ever made was in telephone systems enabling teachers and school officials to send recorded messages to parents, such as notification of a child's unexplained absence or an important schoolwide bulletin.

While district and county administrative data processing departments often provide direct technical support for school-level technology infrastructures, increasingly, teachers are given that responsibility. As school networking becomes more complex, new ways to provide technical support at the school level will be needed. The teacher who coordinates instructional uses of technology for one of the state's largest districts, for example, has a staff of four to keep classroom systems running and instruct teachers in the uses of technology at more than 150 schools. Notes technology teacher Jan Meizel of Davis Senior High School: "Electrical wiring and networking are not the same thing," and school maintenance staff are not equipped to solve network electrical problems. Her teaching duties, Meizel says, leave her with one hour a day to maintain the network, "which is probably not sufficient time."

The California Department of Education has decentralized its school-computing assistance to districts and schools in the last two years, by working with county education departments on regional support for schools and districts with technology questions (California Technical Assistance Project).

Still, the developmental process has a long way to go, acknowledges CUE member Richard Fabian. An educational technology teacher for the San Diego Unified School District, Fabian argues that school uses of technology will remain catch-as-catch-can so long as funding is wholly unpredictable. Now, he points out, schools scramble to "write grants," seek out corporate angels, fix up older equipment and help staff make use of a patchwork of software and hardware.

"We need to move away from the grant mentality, to a cyclical funding idea — like textbook procurement," says Fabian. "We don't adopt new books every year in every subject, but every certain number of years the math or the English purchase comes around." Under a cyclical technology funding process, a percentage of school districts would get an allocation one year, a second group the next and so on until the cycle begins again. "As things are now," he adds, "it is almost impossible to plan, because funding is a constant uncertainty."

Many districts have reallocated existing funds to help address their technology needs. Where funding is flexible and generally adequate to meet a broad range of student needs, the creation from existing resources of a solid operating budget for technology may help move districts toward a more sound funding future. However, for ~~smaller districts and~~ districts with competing funding needs, this option may be a dream that will have to wait for another day.

CONCLUSION

In a state characterized by diversity of people and ideas, Californians agree on one thing: raising the quality of public education — for the sake of our children and for the future of our state. To thrive in the 21st century, all Americans will need to be able to adapt continuously to changes in the nature and organization of work. That will take the intellectual ability to keep learning and developing new skills over the course of a lifetime. This decade's sudden appearance of a global computer networking for ordinary people is just one example, albeit a stunning one, of how quickly a major development can change the human landscape. Little wonder the stakes in education keep getting higher.

As this paper suggests, many unknowns remain amid the educational promise of technology. In a recent report to the President, some of the nation's leading scientists and educators call for expanded research on learning processes, such as in cognitive and developmental psychology, neuroscience, artificial intelligence and cognitive science (which looks at learning, reasoning, memory and perception). The panel also calls for studies linking the findings of cognitive research to development of new educational applications of technology in core academic disciplines and for empirical studies to identify best practices.

The knowledge base in instructional computing is likely to expand significantly in the next few years. Classroom-technology expert Henry Becker of the University of California at Irvine and other researchers are now examining the relative instructional merits of textbooks, lecture and new digital technologies. And the White House science panel strongly recommends that more research funding be directed away from the general question of whether technology can be applied in schools and toward "assessing the effectiveness and cost-effectiveness of specific educational approaches and techniques that make use of the technology."

While such research is imperative, one thing is already clear: As with any tool in any endeavor, computers and network technology are most effective in serving education when chosen and used with a specific education goal in mind. As one conference participant summed it up: "Educators and everyone else concerned about the future of our children need a shared vision of what we want to achieve in our schools. Only then can we begin to understand what needs to happen or change in order to attain those results. And only at *that* point can we begin to identify the tools and other resources required for the job and how they must be targeted if we are to be successful in our efforts."

APPENDIX
PUTTING TECHNOLOGY TO WORK

What follows are some specific examples of how California districts, schools and even individual educators have begun using new technologies. In some cases, the technology has been adopted to address a very specific issue. In other cases, it is seen as a generalizable tool that all teachers and/or students should be able to use for a variety of purposes. In some instances, its usefulness is readily apparent or, at least, readily perceived; in other instances, any pay-off is yet to come. Together, they begin to paint a picture of the variety of ways in which technology is playing out in California schools.

An About-Face

Nine years ago, Foshay Middle School in South Central Los Angeles was declared academically bankrupt and slated for state takeover. Attendance had sunk to 82 percent, the dropout rate was 22 percent and 200-300 suspensions were meted out every year.

Today the Foshay Learning Center is an example of how even a failing inner-city school can be transformed with the right combination of ingredients. They are no mystery: strong, determined, academically focused leadership; faculty members willing to work collaboratively on new instructional approaches and make necessary program changes; a commitment to involving parents in learning; and a schoolwide emphasis on raising all students' achievement in core academic disciplines.

Howard Lappin, the principal sent in when Foshay was at its lowest ebb, also found a way to get the school fully equipped with advanced technologies. His reasoning? If you want students to reach for high academic attainment, put them in an environment that says: this is what it means to be in a serious "learning organization," and these advanced tools are here to help you do your best.

Now a K-12 school with a 3,000-student enrollment that is two-thirds Hispanic, one-third black and 93 percent eligible for Title I services, Foshay last June marked a proud milestone. Its first senior class of 59 students received diplomas and among the graduates were six winners of Cal Grants, 23 applicants to four-year colleges and 30 planning to attend two-year programs. The '97 senior class started out with 72 members, says Lappin; seven moved away and six did not graduate.

Lappin moved first to change the school's climate. "Safety, order and cleanliness were my top priorities," he says. Then he began to institute systemic reforms — school-based management, faculty involvement in decision-making and parental discussions of educational goals for students — to change the school's internal dynamics. And he went after outside funding to support what he was trying to accomplish. Foshay's focus is wholly on core academic subjects, but teaching now is interdisciplinary and thematic, with multiage grouping at the elementary level and an emphasis on team-teaching in two-hour block classes in the middle and upper grades.

As a participant in the New American Schools program, Foshay has been able to equip all classrooms with Internet connectivity and multimedia computers. But Lappin added an extra to teacher training efforts that many schools do not: Foshay teachers who participated in an intensive 13-day program walked away with their own Macintosh Powerbooks for home and school use. That strategy, he says, gives them the ability to communicate with him and each other instantaneously and to explore online instructional resources when they have time, a luxury most teachers still do not have.

Another significant sign of change: The middle-school dropout rate has shrunk to 2 percent and overall attendance has risen to around 96 percent, even though Foshay has the kind of high transiency rate (60 percent) common in inner-city schools. Foshay has been named a 1274 California Demonstration School. And Howard Lappin was honored with a 1996 Heroes of American Education award from the DeWitt Wallace Readers Digest Foundation.

Motivated

Jan Meizel, the technology coordinator (and lone technology "expert") at Davis Senior High School, is not only motivated by technology herself, but has seen it motivate children whose lives are far removed from digital resources.

In the summer of 1996, Meizel and a NASA scientist who helps her develop computer applications for the high school's science curriculum, loaded 19 NASA laptops in a van and took them to Ciudad del Sol, a migrant worker camp outside of Davis. Meizel and her colleague planned to teach classes in principles of aeronautics to any high-school-age young people who were interested. The portables were outfitted only with standard word-processing and spreadsheet software, but Meizel thought the young people might enjoy tinkering with them.

To Meizel's astonishment, about 50 students, some as young as 9, showed up. "I didn't know what would be possible with the software," Meizel says, "but the kids figured out how to use the spreadsheet, graphing and drawing applications to make aeronautical models. They loved it." Meizel subsequently obtained a federal grant to hook Ciudad del Sol to the Internet and is working with the young people to develop a computer-based K-8 aeronautics textbook.

Only a handful of years ago, Meizel herself knew little about telecommunications, although she taught computer science at Davis High. But she decided that the school needed an Internet-linked network and so she set about finding ways to develop one. That took enlisting support from a computer expert at UC-Davis and area businesses, encouraging computer donations and raising funds to underwrite the costs of connectivity. Meizel offers technology training for teachers after school and in the summer. All teachers have e-mail accounts and departmental machines on which they can check their mail. No computer is wasted in her computer lab; if all else fails, it is dismantled by her students and used for parts. "We'll take anything," says Meizel.

Prepared Graduates

The idea for Napa Valley Unified School District's New Technology High School originated five years ago in an uncomfortable meeting called by local businessmen with Napa school officials. "They wanted to know why we weren't graduating people they could hire; they said they had to go out of the area to find the skills they needed," recalls Assistant Superintendent Virginia Rue. "Since our mission as a district is to serve the middle population of students, it was tough to hear that we were not equipping them effectively."

Stung, school leaders convened a district-community group to study the feasibility of creating an academic program that would improve Napa students' standing with employers. "The question was, could we combine a high-tech environment with a core academic curriculum," Rue says. Local citizens' main concern was that the new program might become the preserve of top students only. In the end, they were satisfied that it would benefit "the average students, who are good citizens but typically don't view themselves as college material," says Rue.

New Tech opened last year in an overhauled elementary school, redesigned as an advanced technology environment with funding raised by the district and advice from Silicon Valley experts. The curriculum, for 11th and 12 grade students only, covers English, math (including pre-calculus), physics, social studies and history, as well as courses in computer applications, graphics and multimedia design. The program, Rue notes, fulfills all California State University requirements except advanced foreign language.

But its structure and philosophy differ dramatically from the traditional. The building's interior is open and filled with computer workstations like a modern workplace and students have the freedom of movement that adult workers do. Core academic studies are interdisciplinary in focus (American literature and history are combined and the social studies course combines political literature, U.S. government and economics) and are team-taught by two or more teachers; classes last several hours.

In addition, with the support of area community colleges, New Tech requires all students to take one postsecondary course each semester. And counselors from the colleges come to the school daily to help students think about and plan for the future. "New Tech has been a hook for kids who didn't think they were much, academically," Rue says, adding that their motivation levels have gone "sky-high."

Last year's "Electronic Quilt" project by New Tech's first class illustrates the program's interdisciplinary methods. To celebrate Napa Valley's 150th anniversary, student teams researched and constructed genealogies for local families; mathematically designed a unique quilt pattern for each family; wrote and edited family histories; and created a multimedia presentation on the project that became a CD-ROM demonstrating the integration of core disciplines.

"We arrange for unpaid internships so students can learn about technology-related jobs," Rue concludes. "But we're having trouble filling them because businesses want our kids' skills enough to pay for them."

Internet "Jewels"

Through the Internet, teachers can access a wide array of lesson ideas and instructional resources specifically designed for them by fellow educators and experts in academic disciplines. Many online educational sites are national in scope, but Californians have also created sites intended for the state's own teachers. Here is a sampling:

- California's Computer-Using Educators (CUE), a 10,000-member group that is said to be the oldest and largest such professional organization in the country, has led in establishing a cyberspace outpost that points teachers to resources specifically for instruction and their own professional development. CUE also conducts conferences and technology-training programs and helps advise school districts on technology infrastructure. (http://www.cue.org)

- The Schools of California Online Resources for Educators Project (SCORE) focuses on curriculum resources for K-12 teachers in language arts, history and social studies and science. An initiative funded by the California County Superintendents Educational Services Association and the California Technology Assistance Program, SCORE's web sites contain lesson-plan ideas by subject and grade level, as well as links to other sites that teachers can browse among for useful instructional resources. The lesson plans and sites are selected by committees of educators from across the state who evaluate and annotate their quality before SCORE posts the information. Districts maintaining the sites include Humboldt County (Science, http://intergate.humboldt.k12.ca.us/score/), San Diego County (Language Arts, http://www.sdcoe.k12.ca.us/score/cla.html), Kings County (Mathematics, http://www.kings.k12.ca.us/math/) and San Bernardino and Butte Counties (Social Studies, http://www.rims.k12.ca.us/SCORE/).

- The California Instructional Technology Clearinghouse, administered by the Stanislaus County Office of Education, is a state education department initiative under the California Technical Assistance Project. The clearinghouse conducts evaluations of instructional materials based on effectiveness, technical excellence and appropriateness for use in California classrooms. In 1996, some 100 educators evaluated 127 software and CD-ROM products intended for various grade levels and subjects. Of that group, nine products received the highest rating of "exemplary," 77 were called "desirable," and 39 were deemed unacceptable. Teachers and others can check the clearinghouse's online database to see how a given product was rated and can preview software products at regional software centers. (http://tic.stan-co.k12.ca.us)

- Nationwide, museums, universities, state and federal agencies and scholarly organizations have created online content with both students and educators in mind. Because of the enormous range and quantity of educational materials now available on the Internet, some organizations make it their business to point educators to the most

academically promising sites they can find. For example, the University of Wisconsin Computer Science Department, with support from the National Science Foundation and other funders, produces a biweekly online newsletter called "The Scout Report," whose sole purpose is to alert educators to newly discovered high-quality web sites for research and teaching. To join the electronic mailing list, send email to: listserv@lists.internic.net. In the body of the message, type: subscribe scout-report yourfirstname yourlastname.

Online Case Management

IBM awarded a $2 million grant to San Francisco Unified School District in 1995 to harness the power of technology to improve and streamline services to students who are identified as not progressing at a satisfactory rate in general education. IBM is helping the district develop new software to change the manner in which these services are currently delivered. The grant is part of IBM's Reinventing Education program, an initiative designed to help states and school districts use cutting-edge computer technology to reform and revitalize America's K-12 education system.

Technology can help to customize the most effective intervention for students who need individual and customized instruction. The SFUSD partnered with IBM to create an online case management tool, which will start tracking a student's movement through the system as soon as a teacher finds that a child is at-risk of falling behind. Because the system is online, distance and time barriers that prevent teachers, parents, school administrators, and community members from discussing and taking action on a child's case can be overcome. The case management system engages the support of the whole community through an ever-evolving data bank of school, professional and community resources that can address a child's specific academic or behavioral problems. The system prevents a child's special education placement until the school demonstrates that it has attempted all other appropriate interventions for the child.

To expand the schools' resources, the partnership is also developing an interactive tool for teaching life skills. The tool consists of scenario-based CD-ROMs that focus on information and skills identified as key to the development of personal and social competence.

Bill Rojas, Superintendent of San Francisco Unified, enthusiastically reports that the partnership brings together good educational practice with the latest in information technology to solve real educational problems affecting many students with special needs.

Connecting the Dots

Without skilled teacher-users, district investments in classroom hardware and software remain an unexploited resource.

That was the realization of San Jose Unified School District officials as they fulfilled an ambitious commitment to equip all classrooms with the new technologies that the community felt students must know how to use in studies across the curriculum. Their problem was not

simply how to familiarize teachers with computers and telecommunications technologies. It was also how to help teachers develop technology expertise in their own subject area and the ability to use it in their kit of instructional techniques. District officials soon discovered there was no off-the-rack solution to the training dilemma. So they decided to fashion their own model, recognizing that the project would be experimental and exploratory, but that it could also lead to new professional-development approaches for individual school districts.

Working in partnership with IBM and area universities, the district is creating a computer-based portfolio tool to evaluate the computer skills of pre-service teachers, to support them in their attainment of various teaching standards and to assist practicing teachers in expanding their professional expertise in instructional applications of technology. Using special software and online databases, teachers will be able to assess their own skill level and what additional capabilities they need; find appropriate professional development opportunities in the community; work collaboratively on training with participating university faculty and colleagues; and monitor their own professional progress.

In addition to the portfolio tool, San Jose's professional development project is modeling ways to strengthen teachers' classroom skills through clinical training. For example, in summer school classrooms and on-site workshops, pre-service and experienced teachers collaborated with IBM consultants and faculty from San Jose State University and Stanford University's Accelerated Schools Program, to construct uses for technology fitted to specific instructional situations.

One aim of this project is to institutionalize individual professional development. During the school year, participating summer school and other San Jose teachers will be conducting action research that involves defining a teaching goal; gathering suggestions from partnership members on possible uses of technology; developing and getting responses to a teaching strategy; and receiving help on implementation — all as part of the district's ongoing professional development program.

Electronic Beacon

Effective uses of technology often stem, not from a grand plan, but from one person or group's creative thinking about how to do a particular job better.

Lu Hishmeh, a career teacher and administrator in the Los Angeles Unified School District, confesses to having only a basic word-processing knowledge of computers. But last year she saw a way that telecommunication could help with a districtwide problem: the isolation, uncertainty and stress of the district's thousands of new teachers, particularly its CSR recruits.

Hishmeh worried about them, even though that was not among her responsibilities as a grants administrator in the instructional services division. "New teachers can burn out quickly under the best of circumstances," she says. "And here in LA, where mentor teachers are overburdened with all the new people, I wanted to find a way to help."

Knowing that the new teachers' generation is comfortable with computers, Hishmeh set about using that tool to make helpful guidance for beginners immediately accessible. Now, any new teacher with a computer and modem can go to the district's web site, click on "New Teachers," and find: advisory information about requirements for renewing their credential, with links to enrollment schedules at area colleges and universities; a link to the district's personnel office enabling new teachers to submit questions online and receive answers by e-mail; descriptions of the district's K-3 academic standards, a glossary of literacy terms and links to Internet resources on primary-grades teaching; and some districtwide news groups so that new teachers can participate in professional exchanges online with other teachers.

Hishmeh has also posted standards-based resources for teaching specific lessons and experienced teachers are adding their own lessons for the beginners to study. "These were just my short-term goals," Hishmeh says of her handiwork. Her longer-term goal? "A new teacher gets online, types in information about the type of class and content and gets back a list of recommended lesson plans, a suggested time schedule for covering the material and supporting resources of all kinds."

No Throw-Aways

Tracking — and boosting — student attendance, a perennial burden for administrators, is work that many are using new technologies to lighten. The 15,500-student Napa Valley Unified School District, for example, is a small system with a big distinction: its high-school dropout rate is under 1 percent per year and its annual attendance rate hovers between 98 and 99 percent, even though only one-third of the students who start out in Napa schools graduate from them and Napa is not a high-wealth district (about 40 percent of its students are eligible for Title I services).

That record is attributable in no small measure to Assistant Superintendent for Instructional Services Virginia Rue, who has worried about attendance for more than 20 years. "You can't do anything about it until you go after students and chase 'em with a stick," she says. As a middle-school principal in the late 1970s, Rue won a small state grant to develop an attendance record-keeping system and earned $150,000 in one year for improving attendance levels. The district did not extend the system districtwide, but Rue did persuade officials to purchase automatic telephone-calling equipment, so each school could notify parents of unexplained absences. Ultimately, the district also moved to a computerized attendance system. By then, Rue had moved into her current role (she is also director of secondary education). She has been looking at the monthly reports ever since and working with principals to solve truancy problems case by case. "The printouts used to be pages and pages," Rue says. "Now there may be 15 or 20 names a month."